Study of 4G Mobile Communication System

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Abstract— The development of broadband wireless access technologies in recent years was the result of growing demand for mobile Internet and wireless multimedia applications. Mobile communication plays a most important role in telecommunications industry. Through a common wide-area radio-access technology and flexible network architecture WiMAX and LTE has enabled convergence of mobile and fixed broadband networks. Since January 2007, the IEEE 802.16 Working Group has been developing a new amendment of the IEEE802.16 standard (i.e., IEEE 802.16m) as an advanced air interface to meet the requirements of ITU-R/IMT-advanced for 4G systems as well as for the next-generation mobile network operators. Next fourth generation (4G) mobile technology, promises the full mobility with high speed data rates and high-capacity IP-based services and applications while maintaining full backward compatibility. This paper explores 4G wireless system, its features and technologies to fulfill its requirement.

Index Terms— IEEE 802.16, 4G wireless system, WiMAX.

1 Introduction

A **4G** is the fourth generation of cellular wireless standards ,It is successor to the 3G and 2G families of standards.

The ITU-R organization, in 2008 , specified the **IMT-Advanced** (International Mobile Telecommunications Advanced) requirements for 4G standards which are peak speed for 4G service at 100 Mbit/s for high mobility communication and 1 Gbit/s for low mobility communication

A 4G system must be able to provide a comprehensive and secure all-IP based mobile broadband solution to laptop computer ,wireless modems, smart phones, and other mobile devices. Facilities such as ultra-broadband Internet access, IP telephony, gaming services, and streamed multimedia may be provided to users. The 4G mobile communication systems are expected to solve still-remaining problems of 3G (third generation) systems and to provide a wide variety of new services, from high-quality voice to high-definition video to high-data-rate wireless channels. The 3G system have higher quality voice channels, as well as broadband data capabilities, up to 2 Mbps. But, the two groups could not reconcile their differences, and this decade will see the introduction of two mobile standards for 3G. An intermediate step is being taken between 2G and 3G, the 2.5G. It is basically an enhancement of the two major 2G technologies to provide increased capacity on the 2G RF (Radio Frequency) channels and to introduce higher throughput for data service, up to 384 kbps. A important aspect of 2.5G is that the data channels are optimized for packet data, which introduces access to the Internet from mobile devices like telephone, PDA (Personal Digital Assistant), or laptop.

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2 Key Terms4G Technologies

Some of the key technologies required for 4G are briefly described below:

2.1 Orthogonal Frequency Division Multiplexing (Ofdma)

Orthogonal Frequency Division Multiplexing (OFDM) provides clear advantages for physical layer performance, but also a framework for improving layer 2 performance i.e proposing an additional degree of free- dom. Using OFDM, it is possible to exploit the time domain, the space domain, the frequency domain and even the code domain to optimize radio channel usage. It ensures robust transmission in multipath environments with reduced receiver complexity. It also provides a frequency diversity gain, improving the physical layer performance .It is also compatible with other enhancement Technologies, such as smart antennas and MIMO (multiple-input and multiple-output)radar antenna .OFDM modulation can also be used as a multiple access technology (Orthogonal Frequency Division Multiple Access). In this, each OFDM symbol can transmit information to/from several users using a different set of sub carriers (sub channels). This provides additional flexibility for resource allocation (increasing the capacity), and enables cross-layer optimization of radio link usage.

2.2 Software Defined Radio

Software Defined Radio (SDR) provides high processing power to develop multi-band, multi-standard base stations and terminals. In Future the terminals may be able to adapt the air interface to the available radio access technology which at present is done by the infrastructure. Several infrastructure gains are expected from SDR. For example, to increase network capacity at a specific time (e.g. during a sports event), an operator will reconfigure its network adding several modems at a given Base Transceiver Station (BTS). SDR makes this reconfiguration easy. In context of 4G systems, SDR will become an enabler for the aggregation of multi-standard Pico/micro cells. For manufacturer, this can be a powerful aid to providing multi-standard, multi-band equipment with reduced devel-

opment effort and costs.

2.3 Multiple-Input Multiple -Output

MIMO uses signal multiplexing between multiple transmitting antennas (space multiplex) and time or frequency. It is well suited to OFDM, as it can process independent time symbols as soon as the OFDM waveform is correctly designed for the channel. This aspect of OFDM greatly simplifies processing. The signal transmitted by p antennas is received by q antennas. Processing ofthereceived signals may deliver several performance improvements range, quality of received signal and spectrum efficiency. MIMO is more efficient when many multiple path signals are received. it is generally admitted that the gain in spectrum efficiency is directly related to the minimum number of antennas in the link.

2.4 Handover And Mobility

Handover technologies based on mobile IP technology are for data and voice. Mobile IP techniques are slow but can be accelerated with classical methods (hierarchical, fast mobile IP). These methods are applicable to data and probably voicetoo . In single-frequency networks, it is compulsory to reconsider the handover methods. Several techniques can be used when the carrier to interference ratio is negative (e.g. Variable Spreading Factor Orthogonal Frequency and code Division Multiplexing (VSFOFDM), bit repetition), but the drawback of these techniques is capacity. In OFDM, the same alternative exists as in CDMA, which uses macro-diversity. In OFDM, MIMO allows macro-diversity processing with performance gains. The implementation of macro-diversity implies that MIMO processing is centralized and transmissions are synchronous. This is not as complex as in CDMA, but such a technique should only be used in situations where spectrum is very scarce.

2.5 Security

Security is a major issue in today's communication world. Securities what 4G provide to us are as follows:-

(a) The heterogeneity of wireless networks complicates the security issue.
(b) Dynamic reconfigurable, adaptive, and lightweight security mechanisms should be developed.
(c) Security in wireless networks involves authentication, confidentiality, integrity and authorization for the access of network connectivity and QoS resources for the mobile nodes flow.
(d) AAA (Authentication Authorization Auditing) protocols provide a framework for such problems especially for control plane functions and installing security policies in the mobile node such as encryption, decryption and filtering.

2.6 Benefits

(a) Convergence of cellular mobile networks and WLANs

(i) **Benefits for Operators**:

(aa) Higher bandwidths.
(ab) Lower cost of networks and equipment.
(ac) The use of license-exempt spectrum.
(ad) Higher capacity and QoS enhancement.
(ae) Higher revenue.

(ii) **Benefits for Users:**

(a) Access to broadband multimedia services with lower cost and where mostly needed.
(b) Inter-network roaming.

2.6 Re-Configurable Technology

(a) To use the large variety of services and wireless networks, multimode user terminals are essential as they can adapt to different wireless networks by reconfiguring themselves.
(b) This eliminates the need to use multiple terminals (or multiple hardware components in a terminal).
(c) The most promising way of implementing multimode user terminals is to adopt the software radio approach.

2.7 Re-Configurable Technology Challenges

(a) Regulatory and Standardization issues
(b) Business models
(c) Flexible spectrum allocation and sharing between operators
(d) User preference profiles
(e) Inter-system handover mechanisms and criteria
(f) Software download mechanisms

2.8 Personal Mobility

With terminal mobility, personal mobility is also concern in mobility management. Personal mobility concentrates on the movement of users instead of users' terminals, and involves the provision of personal communications and personalized operating environments. Once the caller's agent identifies user's location, the caller's agent can directly communicate with his agent.

3 APPLICATIONS

(a) **VIRTUAL PRESENCE:** This means that 4G provides user services at all times, even if the user is off-site.
(b) **VIRTUAL NAVIGATION:** 4G provides users with virtual navigation through which a user can access a database of the streets, buildings etc.
(c) **TELE-GEOPROCESSING APPLICATIONS:** This is a combination of GIS(Geographical Information System)

and GPS (Global Positioning System) in which a user can get the location by querying.

(d) **TELE-MEDICINE AND EDUCATION:** 4G will support remote health monitoring of patients.People who are interested in lifelong education, 4G provides a good opportunity.

(e) **CRISIS MANAGEMENT:** Natural disasters can cause breakdown in communication systems. 4G is expected to restore such crisis issues in a few hours.

4 CONCLUSION

As the history of mobile communications , attempts have been made to reduce a number of technologies to a single global standard. 4G systems offer this promise of a standard that can be embraced worldwide through its key concept of integration. Future wireless networks will need to support diverse IP multimedia applications to allow sharing of resources among multiple users. There must be a low implementation complexity and an efficient means of negotiation between the end users and the wireless infrastructure. The fourth generation promises to fulfill the goal of PCC (Personal Computing and Communication) a vision that affordably provides high data rates over a wireless network. In few countries like South Korea and Japan 4G was launched in 2010 and the world is looking forward for the most intelligent technology that would connect the entire globe. In India, MukeshAmbani's Reliance Communications conducted trial for 4G in India, got 80 Mbps Download Speed.

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